Watershed Systems

ID Team Recommended Plan Components

Background: *Watershed condition is the state of the physical and biological characteristics and processes within a watershed that affect the soil and hydrologic functions supporting aquatic ecosystems. Watershed condition reflects a range of variability from natural pristine (functioning properly) to degraded (severely altered state or impaired). Watersheds that are functioning properly have terrestrial, riparian, and aquatic ecosystems that capture, store, and release water, sediment, wood, and nutrients within their range of natural variability for these processes. When watersheds are functioning properly, they create and sustain functional terrestrial, riparian, aquatic, and wetland habitats that are capable of supporting diverse populations of native aquatic- and riparian-dependent species* (Potyondy, et al., 2010).

Watersheds are both areas with discrete physical boundaries and systems governed by complex, interconnected functions and processes. This section includes the plan components required to maintain or restore the ecological integrity of watersheds in the plan area, specifically detailing plan components to maintain or restore structure, function, composition, and connectivity. Watershed systems (i.e., structure, composition, function, connectivity, and integrity) are viewed at multiple analytical scales. Analysis scale followed the Hierarchy Framework of Aquatic Ecological Units in North America (Maxwell et. al 1995). The four analysis scales are: basin (HUC-3), subbasin (HUC-4), watershed (HUC-5), and subwatershed (HUC-6). The smallest scale land unit used in this analysis was the subwatershed (10 to 50 square mile area); consistent with the Watershed Condition Framework (Potyondy, et al., 2010).

The planning regulations (36 CFR Part 219.8) require plan components "to maintain or restore the ecological integrity of terrestrial and aquatic ecosystems … structure, function, composition, and connectivity"; specifically considering the "interdependence of terrestrial and aquatic ecosystems", "system drivers, including dominant ecological processes, disturbance regimes, and stressors", and "opportunities for landscape restoration".

Ecosystem. A spatially explicit, relatively homogeneous unit of the Earth that includes all interacting organisms and elements of the abiotic environment within its boundaries. An ecosystem is commonly described in terms of its:

1. Composition. The biological elements within the different levels of biological organization, from genes and species to communities and ecosystems.

2. Structure. The organization and physical arrangement of biological elements such as, snags and down woody debris, vertical and horizontal distribution of vegetation, stream habitat complexity, landscape pattern, and connectivity.

3. Function. Ecological processes that sustain composition and structure, such as energy flow, nutrient cycling and retention, soil development and retention, predation and herbivory, and natural disturbances such as wind, fire, and floods.

4. Connectivity. Ecological conditions that exist at several spatial and temporal scales that provide landscape linkages that permit the exchange of flow, sediments, and nutrients; the daily and seasonal movements of animals within home ranges; the dispersal and genetic interchange between populations; and the long-distance range shifts of species, such as in response to changing climate. *(36 CFR 219.19)*

Ecological integrity. The quality or condition of an ecosystem when its dominant ecological characteristics (for example, composition, structure, function, connectivity, and species composition and diversity) occur within the natural range of variation and can withstand and recover from most perturbations imposed by natural environmental dynamics or human influence. (36 CFR 219.19)

To address the complexity and interconnected nature of watershed systems, plan components (PCs) are developed in a hierarchal system as follows:

A. Watershed Ecosystem Integrity (PCs)
    a. …
B. Watershed Systems (Ecosystems)
    a. Watershed Structure, Composition, and Connectivity
        i. Aquatic Systems
            1. Physical
                a. Stream Channels, Water Quality, Streamflow, and Sediment Load (PCs)
                b. Groundwater and Groundwater Dependent Ecosystems (PCs)
                c. Public and Municipal Watersheds and Water Supplies(PCs)
            2. Biological (PCs)
                a. T&E species (PCs)
                b. Aquatic Conservation Strategy (PCs)
        ii. Riparian Areas
            1. Riparian Conservation Areas (PCs)
        iii. Terrestrial Areas
            1. Soils (PCs)
                a. Productivity
                b. Quality and Ecosystem Function
            2. Vegetation
                a. Timber (PCs)
                b. Sensitive and T&E species
            3. Wildlife Habitat (PCs)
                a. Sensitive and T&E species
    b. Watershed Function
        i. Watershed Ecosystem Services (PCs)
            1. Clean water (filtration)
            2. Flood control/regulation
            3. Climate regulation
            4. Soil nutrient cycling and retention
            5. Carbon Sequestration
        ii. System Drivers (PCs)
            1. Wildfire
            2. Invasive Species
            3. Insects/Disease
            4. Climate Change
            5. Management Activities

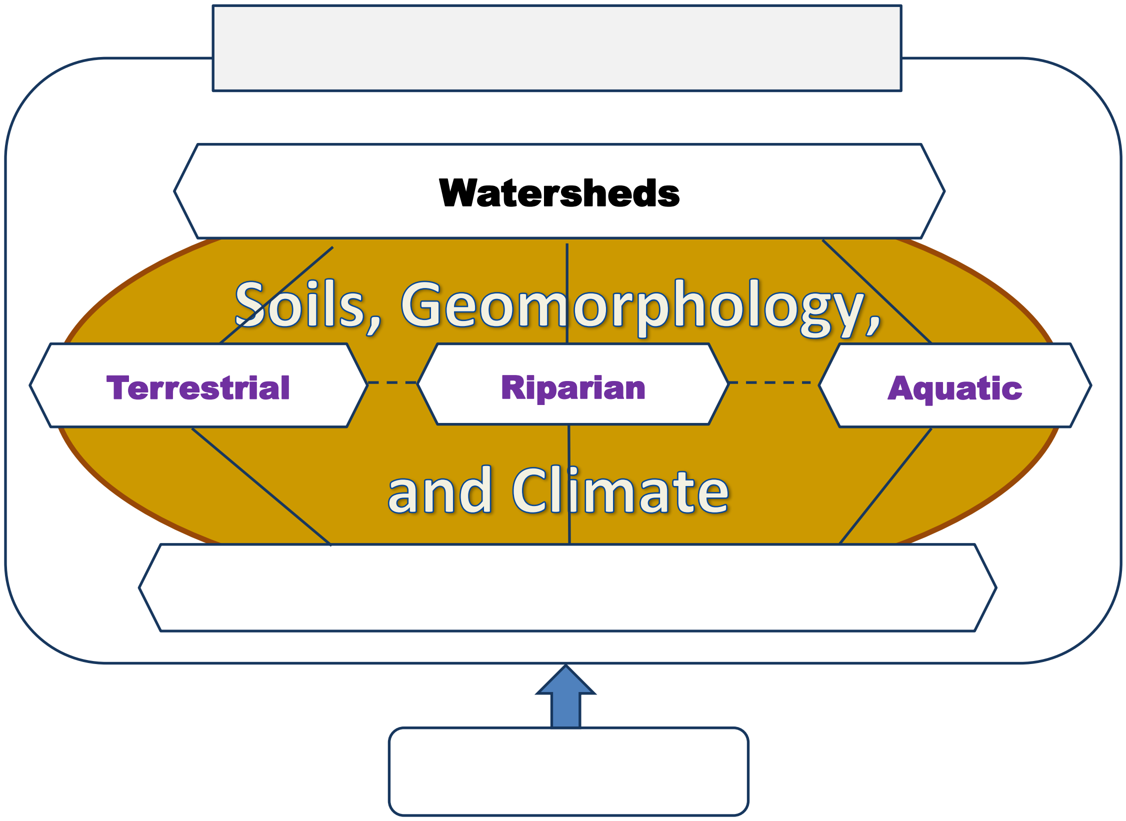

Figure 2. Watershed ecosystem components.

Watershed Ecosystem Integrity

Background:

As described in the planning regulations (36 CFR 219), the goal of managing for watershed ecosystem integrity is: [to] *maintain or restore the ecological integrity of terrestrial and aquatic ecosystems and watersheds;* [to] *maintain or restore structure, function, composition, and connectivity of watersheds;* [to maintain or restore] *the interdependence of terrestrial, riparian, and aquatic ecosystems.*

For this plan component, the term *watershed* refers specifically to 6th-level hydrologic unit code (HUC-6) scale watersheds[1], unless otherwise indicated. *The Watershed Condition Framework (Potyondy, et al., 2010) classification defines watershed condition in terms of "geomorphic, hydrologic and biotic integrity" relative to "potential natural condition." In this context, integrity relates directly to functionality. Geomorphic functionality or integrity can be defined in terms of attributes such as slope stability, soil erosion, channel morphology, and other upslope, riparian, and aquatic habitat characteristics. Hydrologic functionality or integrity relates primarily to flow, sediment, and water-quality attributes. Biological functionality or integrity is defined by the characteristics that influence the diversity and abundance of aquatic species, terrestrial vegetation, and soil productivity. In each case, integrity is evaluated in the context of the natural disturbance regime, geoclimatic setting, and other important factors within the context of a watershed. The definition encompasses both aquatic and terrestrial components, because water quality and aquatic habitat are inseparably related to the integrity and, therefore, the functionality of upland and riparian areas within a watershed. The three watershed condition classes are directly related to the degree or level of watershed functionality or integrity:*

Class 1 = Functioning Properly.
Class 2 = Functioning at Risk.
Class 3 = Impaired Function.

The Watershed Condition Framework (WCF) system consists of 12 watershed condition indicators (Figure 2), each with three defined classes (Potyondy, et al., 2010), that are surrogate variables representing the underlying ecological, hydrological, and geomorphic functions and processes that affect watershed condition. Each of the subheadings below, describes 'Functioning Properly' for each of the 12 watershed condition indicators. This system provides the basis for the desired condition of watershed systems. Objectives, Standards, and Guidelines for Watershed Ecosystem Integrity are intended to address watershed health as a whole system. Although Plan Components are developed here for some of the 12 indicators, the majority of objectives for these 12 indicators are developed in their respective sub-sections of the Forest Plan (e.g., Water Quality, Soils).

<u>Water quality</u>: for both surface and groundwater, there is minimal to no impairment to beneficial uses (as designated by the State of Idaho's Department of Environmental Quality) of the water bodies in the watershed occurs. There are no Clean Water Act Section 303(d) State-listed impaired or threatened water bodies. There are no documented areas of excessive sediment, nutrients, chemical pollution or other water quality issues above natural or background levels; no consumption advisories or contamination from abandoned or active mines; and little or no evidence of acidification, toxicity, or eutrophication because of atmospheric deposition.

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[1] The 6th-level HUC is correctly identified as a sub-watershed scale.

Water quantity: Each watershed has primarily free-flowing rivers and streams, unmodified lakes, and no or limited ground water withdrawals. Stream hydrographs have no or minor departure from natural conditions. There are no significant man-made reservoirs, dams, or diversion facilities.

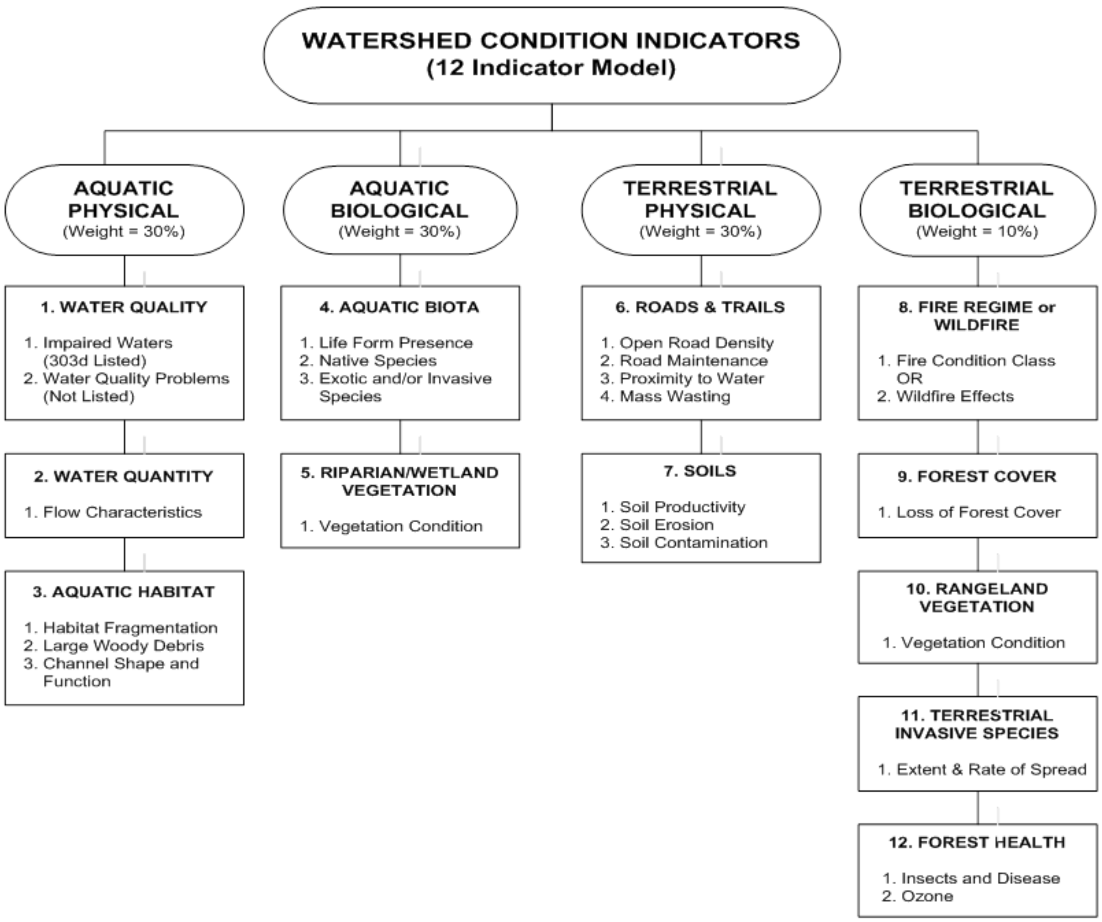

Figure 3. Watershed condition framework, 12-indicator model

Aquatic habitat: Each watershed supports large continuous blocks of high-quality aquatic habitat and stream channel conditions. Habitat fragmentation is minimal (more than 95 percent of historic aquatic habitats are still connected). In aquatic and riparian systems that evolved with wood near the streams, large woody debris is present and continues to be recruited into the system at near natural rates. Channel width-to-depth ratios exhibit the range of conditions expected in the absence of human influence. Less than 5 percent of the stream channels show signs of widening beyond expected ranges. Channels are vertically stable, with isolated locations of aggradation or degradation; which would be expected in near natural conditions. The distribution of channels with floodplain connectivity is close to that found in reference watersheds of similar size and geology.

Aquatic biota: All native aquatic communities and life histories appropriate to the site and watershed are present and self-maintaining. More than 90 percent of expected aquatic life forms and communities are present based on the potential natural communities present. Most native aquatic species and life histories that would be expected based on potential natural communities are present and self-maintaining. Limited intermixing of native species genetics with outside sources has occurred, which can happen when moving aquatic species from one aquatic habitat to another. Exotic and/or aquatic invasive species may be present but they have not greatly altered condition of native species (less than 25 percent of the historic aquatic-life-bearing habitats have exotic and/or aquatic invasive species present, spread of exotics and/or aquatic invasive species have been minimal over the past decade).

Riparian/Wetland Vegetation Condition: Native vegetation exists throughout the riparian conservation areas; and adjacent to wetlands, floodplains, and water bodies. Native mid to late seral vegetation appropriate to the site's potential dominates the plant communities and is vigorous, healthy, and diverse in age, structure, cover, and composition on more than 80 percent of the riparian/wetland areas in the watershed. Sufficient reproduction of native species appropriate to the site is occurring to ensure sustainability. Mesic herbaceous plant communities occupy most of their site potential. Vegetation is in a dynamic equilibrium appropriate to the stream or wetland system.

Roads and trails: The density and distribution of roads and trails within the watershed indicate that the hydrologic regime is substantially intact and unaltered. Road densities at the subwatershed scale are at the minimum network necessary to provide access for other resources and minimize effects to aquatic resources. The system road and trail density are each less than 1 mi/mi^2 in each watershed. No more than 10 percent of road and trail length in any watershed is located within 300 feet of streams and water bodies, or are hydrologically connected to them. For each watershed, less than 0.25 mi/mi^2 roads are on unstable landforms or soil types subject to mass wasting, and there is little evidence of active movement or evidence of road damage. Best Management Practices (BMPs) for the maintenance of designed drainage features are applied to more than 75 percent of the roads, trails, and water crossings in the watershed. There is no delivery of large quantities of debris to stream channels because of road-related mass wasting.

Soils condition[2]: There is only minor (<5%) or no alteration to reference soil conditions, including erosion, productivity, and chemical characteristics. Soil nutrient and hydrologic cycling processes are functioning at site potential levels. The ability of the soil to maintain resource values and sustain outputs is high in the majority (>95%) of the watershed. Evidence of management-related surface erosion is generally absent over the majority (>95%) of the watershed. No substantial areas (>1/2 acre) of soil contamination exist in the watershed.

Fire Regime or Wildfire Condition: A predominate percentage of the watershed (>66%) is within the natural (historical) range of variability ("reference fire regime") of vegetation characteristics; fuel composition; fire frequency, severity, and pattern; and other associated disturbances[3]. The vegetative species and cover types are well adapted to the fire regime and offer good protection to soil and water resources. Following a significant wildfire, effects are such that soil and ground cover conditions in the burned area are expected to recover within 1 to 2 years to levels that provide watershed protection appropriate for the location and ecotype.

Forest Cover: In areas where trees desired provide 10% or greater canopy cover and are part of the dominant (uppermost) vegetation layer[4], including areas that have been planted to produce woody crops, less than 5% of National Forest System (NFS) land in the watershed contains cut-over (and not yet

[2] Although this is the definition used by WCF (Potyondy, et al., 2010), the Forest is developing a desired future condition for soils that might be different.
[3] This definition is following the Fire Regime Condition Class (FRCC) 1.
[4] These lands do not include rangelands or areas that naturally have less than 10% canopy cover.

replanted), denuded, or deforested forest land (i.e., permanent removal of previously forested lands, but not including roads, trails, recreation, or administrative facilities).

Rangeland vegetation: Rangelands reflect native or desired nonnative plant composition and cover at near-natural levels as defined by the site potential. Vegetation contributes to soil condition, nutrient cycling, and hydrologic regimes at near-natural levels; functional/structural groups, number of species, plant mortality and decadence closely match that expected for the site, such that average annual plant production equals or exceeds 70 percent of production potential; litter amount is approximately what is expected for the site potential and climatic conditions; the reproductive capacity of native or naturalized perennial plants to produce seeds or vegetative tillers is sustainable over the long term; and introduced plant species are being managed to facilitate long-term replacement by site-adapted native species.

Terrestrial Invasive species: Few (< 10%) or no populations of terrestrial invasive species infest the watershed that could necessitate removal treatments to protect, soil, native vegetation, or other water resources. Those that occur are small in extent and scattered in nature. The rate of spread and/or potential for impact on watershed resources is minimal or unlikely.

Forest Health: Less than 20% of the forested land in the watershed is at imminent risk of abnormally high levels of tree mortality because of insects and disease.

Connectivity: There is spatial connectivity and interdependence within and between watersheds. Watersheds exhibit a high degree of connectivity longitudinally along the stream between floodplains, wetlands, upslope areas, headwater tributaries, and intact habitat refugia; laterally across the floodplain and valley bottom; and vertically between surface and subsurface flows. These network connections provide chemically and physically unobstructed routes to areas critical for fulfilling life history requirements of aquatic, riparian-dependent, and many upland species of plants and animals. For Forest planning, spatial connectivity is between watersheds (HUC-6) at the subbasin scale (HUC-4). For project planning, spatial connectivity is between subwatersheds (HUC-6) at the watershed scale (HUC-5).

Aquatic System (Physical): Stream Channels, Water Quality, Streamflow, and Sediment Load

<u>Background:</u>

Water quality can be separated into two basic categories: 1) water for drinking and 2) water to support beneficial uses (e.g., fish and wildlife). Forests and grasslands have long been relied upon as sources of clean drinking water for two reasons: (1) forests mainly grow under conditions that produce relatively reliable water runoff, and (2) properly managed forests and grasslands can yield water relatively low in contaminants when compared with many urban and agricultural land uses. There are a myriad of laws, both State and Federal, which govern water quality. However, the primary laws are the Federal Clean Water Act and Safe Drinking Water Act. Idaho DEQ has been delegated authority by the federal government to administer Idaho's Drinking Water Program under the provisions of the federal Safe Drinking Water Act and the Idaho Rules for Public Drinking Water Systems; while the Environmental Protection Agency administers the Clean Water Act.

<u>Clean Water Act, Safe Drinking Water Act, and Idaho State Water Quality Laws</u>
The U.S. Congress justified passing the Safe Drinking Water Act Amendments of 1996 (SDWA) [Public Law 104–182, codified at 42 U.S.C. sec. 300j–14], by stating "safe drinking water is essential to the protection of public health." The Safe Drinking Water Act (SDWA) is the main federal law that ensures the quality of Americans' drinking water. Under SDWA, EPA sets standards for drinking water quality and oversees the states, localities, and water suppliers who implement those standards. SDWA was originally passed by Congress in 1974 to protect public health by regulating the nation's public drinking water supply. The law was amended in 1986 and 1996 and requires many actions to protect drinking water and its sources: rivers, lakes, reservoirs, springs, and ground water wells. (SDWA does not regulate private wells which serve fewer than 25 individuals.)

The Clean Water Act (CWA) [(Public Law 80–845), codified at 33 U.S.C. Sec.1251] is the primary federal law in the United States governing water pollution.[1] Passed in 1972, the act established the goals of eliminating releases of high amounts of toxic substances into water, eliminating additional water pollution by 1985, and ensuring that surface waters would meet standards necessary for human sports and recreation by 1983. Point sources may not discharge pollutants to surface waters without a permit from the National Pollutant Discharge Elimination System (NPDES). This system is managed by the United States Environmental Protection Agency (EPA) in partnership with state environmental agencies.

The Idaho Department of Environmental Quality's (IDEQ's) Water Quality Division is responsible for ensuring that Idaho's surface, ground, and drinking water resources meet state water quality standards.

In addition there are Executive Orders 11988 and 11990 regarding Floodplain and Wetland Management. EO 11988 directs the Forest to "*restore and preserve the natural and beneficial values served by floodplains*". EO 11990 directs the Forest to "*minimize the destruction, loss or degradation of wetlands*". .

A provision of the Organic Act of 1897 (30 Stat. 11), [codified at 16 U.S.C. Subsec. 473–475, 477–482, 551], that established the national forests "for the purpose of securing favorable conditions of water flows," has been interpreted to authorize managing his land for water resources.

Aquatic System (Physical): Groundwater and Groundwater Dependent Ecosystems

<u>Background:</u>

<u>Groundwater:</u>

Ground water and surface water are interconnected and interdependent in almost all ecosystems. Ground water plays significant roles in sustaining the flow, chemistry, and temperature of streams, lakes, springs, wetlands, and cave systems in many settings, while surface waters provide recharge to ground water in other settings. Ground water has a major influence on rock weathering, streambank erosion, and the headward progression of stream channels. In steep terrain, it governs slope stability; in flat terrain, it limits soil compaction and land subsidence. Slow drainage of soil moisture in the range of field capacity is the source of a large proportion of the baseflow of forested headwaters streams, where organic matter content of forest soils tends to be high (USFS, 2007). Ground water can play an important role in slope movements because its presence in soil pores reduces slope stability. Slope movements often occur during the wet season, or following major rainfall or snowmelt events. Ecological resources include sensitive fish, wildlife, plants, and habitats that are at risk from exposure to ground water contaminants or ground water depletion.

Baseflow is that part of streamflow derived from groundwater discharge and bank storage. River flow is often maintained largely by ground water, which provides baseflow long after rainfall or snow melt runoff ceases. The baseflow typically emerges as springs or as diffuse flow from sediments underlying the river and banks. Localized areas of ground water discharge have a largely stable temperature and provide thermal refuges for fish in both winter and summer. The ground water level in riverine aquifers is important for maintaining a hydraulic gradient towards the stream that supports the necessary discharge flux. Sufficient discharge of ground water is needed to maintain the level of flow required by the v

Figure 4. Watershed ecosystem components.

other contaminants may adversely affect dependent ecosystems in baseflow-dominated streams. The interface between saturated ground water and surface water in streams and rivers is a zone of active mixing and interchange between the two and is known as the hyporheic zone (Jones and Mulholland 2000, Stanford and Ward 1988, 1993). In mountain streams with typical pool-and-riffle organization, ground water enters streams most readily at the upstream end of deep pools, and conversely, surface water moves into the subsurface beneath and to the sides of riffles (Harvey and Bencala 1993).

Lakes, both natural and human made, can have complex ground water flow systems (Fetter 2000). Lakes interact with ground water in one of three basic ways: (1) some receive ground water inflow throughout their entire bed; (2) some have seepage loss to ground water throughout their entire bed; and (3) others, perhaps most, receive ground water inflow through part of their bed and have seepage loss to ground water through other parts (Winter and others 1998). A similar mixing zone to the hyporheic zone, called the hypolentic zone, occurs at the interface between saturated ground water and surface water in lakes and wetlands. In many lakes, the most active portion of the hypolentic zone is located in the littoral zone in close proximity to the shoreline (Hunt and others 2003, McBride and Pfannkuch 1975).

Pumping of ground water can reduce river flows, lower lake levels, and reduce or eliminate discharges to wetlands and springs. It also can influence the sustainability of drinking-water supplies and maintenance of critical ground water-dependent habitats. Management activities that intentionally or unintentionally influence the density, structure, and species composition of vegetation may have measurable effects on the quantity and quality of ground water (USFS, 2007). Certain land uses are known to cause ground water contamination. Specific types of contaminants are associated with specific types of land uses and industries. The Office of Technology Assessment of the US Congress (1984) identified the following six categories of major sources of ground water contamination:

1. Sources designed to discharge substances—septic tanks, injection wells, land application of waste.
2. Sources designed to store, treat, or dispose of substances—landfills, surface impoundments, mine waste, storage tanks.
3. Sources designed to retain substances during transport—pipelines, material transport and transfer.
4. Sources discharging substances as a consequence of other planned activities—irrigation, pesticide and fertilizer application, road salt, urban runoff, mine drainage.
5. Sources providing a conduit for contaminated water to enter aquifers—wells, construction excavation.
6. Naturally occurring sources whose discharges are created or enhanced by human activity—ground water/surface-water interaction, natural leaching, saltwater intrusion.

Groundwater quality meets applicable State water quality standards and fully supports designated beneficial uses. The Forest has no land uses are known to cause ground water contamination; or where these activities occur, these activities do not occur in size, number, or proximity to groundwater such that groundwater is contaminated. Pumping of ground water is only at levels that do not reduce river flows, lower lake levels, and reduce or eliminate discharges to wetlands and springs. There are no ecological resources, including sensitive fish, wildlife, plants, and habitats that are at risk from exposure to groundwater contaminants or ground water depletion.

Seasonal flows recharge riparian aquifers and provide late season baseflow and cold water temperatures to streams, lakes, rivers, GDEs and riparian areas. Groundwater and surface water have interconnected and interdependent flow conditions that occur in watersheds, streams, lakes, springs, wetlands (including peatlands), and groundwater aquifers to fully support beneficial uses, and meet the ecological needs of native and desirable non-native aquatic species and maintain the physical integrity of their habitats.

Groundwater Dependent Ecosystems:

In general, where groundwater intersects the ground surface, plants and animals that are supported by access to that groundwater will occur, hence the term "groundwater-dependent ecosystems." Ground water-dependent ecosystems are communities of plants, animals and other organisms whose extent and life processes depend on ground water. The following are examples of some ecosystems that may depend on ground water:

- Wetlands in areas of ground water discharge or shallow water table.
- Terrestrial vegetation and fauna, in areas with a shallow water table or in riparian zones.
- Aquatic ecosystems in ground water-fed streams and lakes.
- Cave and karst systems.
- Aquifer systems.
- Springs and seeps.

In some cases, groundwater emerges at a point location, usually called a spring or seep, depending on the quantity of water available. The term "spring" will be used to include both springs and seeps. Springs are always GDEs. Springs occur where water flowing through aquifers discharges at the ground surface through fault zones or fractures, or by flow along an impermeable layer (USFS, 2007). Springs are replenished by precipitation that percolates into aquifers by seeping into the soil and entering fractures, joints, bedding planes, or interstitial pore space. Springs can be important sources of water to streams, lakes, riparian areas, and groundwater dependent ecosystems. Spring ecosystems include aquatic and riparian habitats that are similar to those associated with rivers, streams, lakes, and ponds. They are distinctive habitats because they provide relatively constant water temperature, depend on subterranean flow through aquifers, and on occasion provide refuge habitats that support species that occur only in springs. Ground water development can reduce spring flow, change springs from perennial to intermittent, eliminate springs altogether, or affect the chemical composition of the spring water (USFS, 2007).

Shallow ground water can support terrestrial vegetation, such as forests and woodlands, either permanently or seasonally (Baird and Wilby 1999). Examples occur in riparian areas along streams (Hayashi and Rosenberry 2002) and in upland areas that support forested wetland environments. Phreatophytes are plants whose roots generally extend downward to the water table and are common in these high-water-table areas. Ground water-dependent terrestrial plant communities provide habitat for a variety of terrestrial, aquatic, and marine animals. Some ecosystems, such as floodplains, exist along a continuum between fully aquatic communities and fully aquifer communities.

In the case of wetlands supported by groundwater, often there is not a single point where the groundwater flows or emerges at the surface; rather, it usually emerges in a more diffuse manner across a large area. In some wetlands, however, springs emerge within the wetland, or a complex of wetlands and springs is present across an area. In many cases, groundwater-dependent wetlands, such as fens, are simply springs covered by unconsolidated material (such as glacial deposits, pumice, and colluvium) that becomes saturated to the surface. Because an indistinct boundary exists between springs and wetlands dependent on groundwater discharge, a single field guide was developed for these systems. Groundwater emerging at the ground surface is the common thread that links these features and their associated ecosystems (USFS, 2007). Similar to streams and lakes, wetlands can receive inflow from ground water, recharge ground water, or do both. The persistence, size, and function of wetlands are controlled by hydrologic processes active at each site (Carter 1996). For example, the persistence of wetness for many wetlands depends on a relatively stable influx of ground water throughout seasonal and annual climatic cycles. Wetlands can be quite sensitive to the effects of ground water pumping. This pumping can affect wetlands not only by lowering the water table, but also by increasing seasonal changes in the elevation of the water table and exposing accumulated organic and inorganic material to oxidation.

Fens are peat-forming wetlands that receive recharge and nutrients almost exclusively from ground water. The water table is at or just below the ground surface. Water moves into fens from upslope mineral soils, and flows through the fen at a low gradient. Fens differ from other peatlands because they are less acidic and have higher nutrient levels; therefore, they are able to support a much more diverse plant and animal community. Grasses, sedges, rushes, and wildflowers often cover these systems. Over time, peat may build up and separate the fen from its ground water supply. When this happens, the fen receives fewer nutrients and may become a bog. Patterned fens are characterized by a distribution of narrow, shrub-dominated ridges separated by wet depressions. Fens provide important benefits in a watershed, including preventing or reducing the risk of floods, improving water quality, and providing habitat for unique plant and animal communities. Like most peatlands, fens have experienced a decline in acreage, mostly from mining and draining for cropland, fuel, and fertilizer. Because of the large historical loss of this ecosystem type, remaining fens are rare but do exist on the Forest. While mining and draining these ecosystems provide resources for people, up to 10,000 years are required to form a fen naturally (USFS, 2007).

The Forest supports a wide variety of GDEs, including peatlands, bogs, fens, wetlands, seeps, springs, riparian areas, groundwater-fed streams and lakes, and groundwater aquifers. Groundwater flows sustain the function of these GDEs with interconnected and interdependent surface and subsurface aquatic ecosystems. The timing, variability, and water table elevation in GDEs, including, is within the natural range of variability.

Wetlands receive inflow from ground water and recharge ground water, such that there is a relatively stable influx of ground water throughout seasonal and annual climatic cycles. The persistence, size, and function of wetlands are controlled by hydrologic processes active at each site, and are not interrupted by management activities. Groundwater-fed wetlands and riparian areas along streams support phreatophytic vegetation communities either permanently or seasonally. Ground water-dependent terrestrial plant communities provide habitat for a variety of terrestrial and aquatic animals native to the Forest.

Seeps and springs occur where water flowing through aquifers discharges at the ground surface through fault zones or fractures, or by flow along an impermeable layer. Springs are replenished by precipitation that percolates into aquifers by seeping into the soil and entering fractures, joints, bedding planes, or interstitial pore space. Where springs are important sources of water to streams, lakes, riparian areas, and groundwater dependent ecosystems, these systems of interconnected and interdependent flows are uninterrupted by management activities. Spring ecosystems maintain distinctive habitats by providing relatively constant water temperature and on refuge habitats that support species that occur only in springs. Ground water developments do not reduce spring flow, change springs from perennial to intermittent, eliminate springs altogether, or affect the chemical composition of the spring water.

Peatlands (including fens and bogs) support natural unique plant and animal communities, and provide habitat for rare plant and animal species. Peatland water flows, water quality, water chemistry, soil, organic substrate, and plant communities function under conditions characteristic of how they evolved. Upland areas surrounding peatlands that have the most direct influence on peatland characteristics, and stream segments that flow directly into peatlands are managed to sustain the natural characteristics and diversity of those peatlands.

Aquatic System (Physical): Municipal Watersheds

Background: (From 36 CFR 251)

251.9 - Management of Municipal Watersheds.(a) The Forest Service shall manage National Forest watersheds that supply municipal water under multiple use prescriptions in forest plans (36 CFR part 219). When a municipality desires protective actions or restrictions of use not specified in the forest plan, within agreements, and/or special use authorizations, the municipality must apply to the Forest Service for consideration of these needs.

(b) When deemed appropriate by the Regional Forester, requested restrictions and/or requirements shall be incorporated in the forest plan without written agreements. Written agreements with municipalities to assure protection of water supplies are appropriate when requested by the municipality and deemed necessary by the Regional Forester. A special use authorization may be needed to effect these agreements.

(c) In preparing any municipal watershed agreement for approval by the Regional Forester or issuing special use authorization to protect municipal water supplies, the authorized forest officer shall specify the types of uses, if any, to be restricted; the nature and extent of any restrictions; any special land management protective measures and/or any necessary standards and guidelines needed to protect water quality or quantity; and any resources that are to be provided by the municipality.

(d) A special use authorization (36 CFR 251.54) is required if the municipality is to use the subject lands, restrict public access, or control resource uses within the watershed. Special use authorizations issued pursuant to this section are subject to the same fee waivers, conditions, and procedures applicable to all other special uses as set forth in subpart B of this part.

(e) Any municipal watershed management agreements, special use authorizations, requirements, and/or restrictions shall be consistent with forest plans, or amendments and revisions thereto.